

2026

Agri-footprint 8 Methodology Report

Part 1: Methodology and basic principles

Better Food. Better Health. Better World.

About us

Agri-footprint is a high-quality, comprehensive life cycle inventory (LCI) database focused on the agriculture and food sector. It covers data on agricultural products: food, feed, and agricultural intermediate products. Since its conception in 2014, Agri-footprint has been critically reviewed and is now widely accepted by the food industry, LCA community, scientific community, and governmental institutions.

Mérieux NutriSciences | Blonk is a leading international expert in food system sustainability, inspiring and enabling the agri-food sector to give shape to sustainability. Our purpose is to create a sustainable and healthy planet for current and future generations. We support organizations in understanding their environmental impact in the agri-food value chain by offering advice and developing tailored software tools based on the latest scientific developments and data.

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Methodology and basic principles

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1. Introduction

The Agri-footprint database is a relevant source of LCA information for agricultural production and processing of commodities for a wide range of different users. Since the first release in 2014 the database has been expanded and updated 7 times to arrive at the current Agri-footprint 8 version. Now, Agri-footprint has become the core database to be used in (carbon) footprinting reports and footprint declarations for several industrial sectors. It is particularly of interest for the feed sector since it's the source database for the Global Feed Lifecycle Institute (GFLI) database, the European Commission EF feed databases, and therefore for all animal sectors that want to generate compliant footprinting studies.

Agri-footprint aims to be compliant with the most widely used methodology standards for agricultural and food LCA and footprinting by connecting to data from leading statistical institutes (such as FAO and Eurostat), industry publications, and scientific literature. For agricultural modelling, the product environmental footprint calculation rules are followed as published in the latest PEF guidelines, (EU) 2021/2279 “Commission Recommendation of 15 December 2021 on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organizations.”

Agri-footprint for purchase via our [Sales representatives](#), is available as a library within SimaPro, OpenLCA Nexus, HiQLCD and Earthster. It is expected that Agri-footprint users have a basic understanding of life cycle assessment concepts. Blonk can also provide bespoke training sessions to build capacity in other organizations at request. General information, FAQ, Update Logs, Issue Trackers, and reports are publicly available on www.agri-footprint.com. Agri-footprint users can also ask questions via this website or by sending inquiries to tools@blonksustainability.nl.

Agri-footprint is published by Mérieux NutriSciences | Blonk. More information on Mérieux NutriSciences | Blonk and Agri-footprint can be found at blonksustainability.nl and blonksustainability.nl/agri-footprint.

This document contains background information on the methodology, calculation rules and data that are used for the development of the data published in the Agri-footprint database. It will be updated whenever new or updated data is included in a new release of Agri-footprint.

Part 1 of the Agri-footprint methodology describes the main methodological principles for the setup, development, and maintenance of the Agri-footprint data. In Part 2, more detailed information is given on the specific methodological assumptions and data used for developing the different datasets. In Part 3, more detailed information can be found in the impact of the latest update, comparing Agri-footprint 7 versus the latest Agri-footprint 8.

2. Using the Agri-footprint data

2.1 Target users

The Agri-footprint database is useful for all parties that want to study and report on the LCA impact of products and services originating from agriculture and fisheries. This can be:

- LCA researchers and consultants, government research organizations, academia
- Operators that conduct product or company footprints, research and development
- Service providers (e.g. software developers) that develop tools for footprinting-related decision support
- Database developers that provide secondary data for certain related industries

For all use cases there are specific License Agreements. The 5 license types are the Research License, Commercial License, Consultancy License, Developer License, and Enterprise License. More information on the license offering can be found at www.blonksustainability.nl/agri-footprint.

The Agri-footprint database contains agriculture crop data, data from fisheries, data on animal production systems, and data on products processed to commodities and ingredients. Therefore, typical users are in the agricultural industry where products are composed of multiple ingredients to a product.

2.2 Intended use

Agri-footprint aims to support both type A (“Micro-level decision support”) and C (“Accounting”) applications, including interactions with other systems (C1) as well as isolated systems (C2), as described in the ILCD guidelines (JRC-IES & European Commission, 2010). Agri-footprint is based on an attributional approach. This means that the results give an impression of the environmental impact of a product in the current situation. Agri-footprint does not aim to support type B (“Meso/macro-level decision support”), where LCI modelling exclusively refers to those processes that are affected by large-scale consequences. The processes in Agri-footprint are not modelled in a consequential way.

Agri-footprint can be used as a secondary data source to support comparisons or comparative assertions across systems (e.g. products). In case an LCA should be used to make public claims, it is the responsibility of the practitioner to ensure ISO 14040:2006/14044:2006 compliance (through an ISO review of the study). Furthermore, Agri-footprint agricultural modelling is fully compliant with the Product Environmental Footprint (PEF) guidelines (Commission Recommendation (EU) 2021/2279). This document provides all relevant information to facilitate this process, through transparent documentation of methodological choices and through description of data sources and modelling (see Agri-footprint 8 - Part 2 – Description of data). In some comparative LCA cases, a consequential approach may be more appropriate. In that case, the user may need to modify the LCIs to accurately reflect marginal effects.

More specifically, potential applications of Agri-footprint may be:

- The identification of key environmental performance indicators of a product group
- Hotspot analysis of a specific agricultural product
- Benchmarking of specific products against a product group average.

- Provide policy information for identifying product groups with the largest environmental impact in a certain context
- Carbon footprints and other partial footprints
- Environmental product declarations (EPD)

In addition, a separate Agri-footprint ‘FLAG’ database has been developed, using linear amortization of land use change emissions. This specific version of the database has specific reporting requirements from SBTi (Greenhouse Gas Protocol, 2026; SBTi, 2026) and can be used for:

- SBTi target setting and reduction, using contribution results specifically modelled using FLAG pathways.

Agri-footprint may also support other applications; however additional modelling (or modification of datasets) will be required:

- Strategic decision-making through forecasting and analysis of the environmental impact of raw material strategies and identification of product groups or raw materials with the largest environmental improvement potential
- Detailed product design of food products, in which the data from Agri-footprint can be used as a starting point which can be partially replaced by primary or more specific data where needed
- The development of life cycle-based Eco label criteria, but does not provide Eco label criteria directly
- Agri-footprint can be referred to as a prescribed secondary data source to be used in life cycle based environmental declarations of specific (food) products under the Product Environmental Footprint (PEF) framework, or in Product Category Rules (PCRs).

Agri-footprint is not intended to be used:

- As the only source for green public or private procurement, as Agri-footprint does not (yet) provide sufficient data on supplier or brand-specific products (although this may change in the future, as incorporation of supplier specific data is desired).
- Agri-footprint is not intended for corporate or site-specific environmental reporting or environmental certification of specific life cycles, although Agri-footprint may be used as a source for background data.

Agri-footprint provides LCI datasets which were modelled on the unit process level using models and data that were developed by Blonk. The database is available in three versions: Impact Result Level, System Process Level, and Unit Process Level. Agri-footprint unit processes are linked so that detailed, interconnected, LCI models can be applied directly as input into LCAs.

Agri-footprint uses some background data from other databases such as Ecoinvent. A list of these datasets is provided in the data report (Agri-footprint 8 - Part 2 – Description of data).

3. Methodology and scope

3.1 Life Cycle Assessment (LCA) framework for agriculture

Life cycle assessment (LCA) is a methodological framework for assessing the environmental impacts that can be related to the production and use of a product or service. Examples of environmental impacts are climate change, toxicological stress on human health and ecosystems, depletion of resources, water use, and land use.

There are several LCA protocols and guidelines, such as the ISO standards, for practitioners that give directions on how to conduct an LCA.

Important LCA standards and handbooks that were used as a basis for the LCIs in Agri-footprint are:

- The ISO 14040/44 series (ISO 14040, 2006; ISO 14044, 2006, 2020)
- Product Environmental Footprint (PEF) methodology (European Commission, 2018a)
- Several Product Environmental Footprint Category Rules PEFCRs such as feed, dairy and pet-food
- Forest, land and agriculture science based target-setting guidance (Greenhouse Gas Protocol, 2026; SBTi, 2026) for FLAG emission reporting of the AFP FLAG variant.

The ISO 14040 series (ISO 14040, 2006) describe the basic requirements for performing an LCA study. This includes, among other things, directions on how to define the functional unit of a product, how to determine which processes need to be included or excluded, and how to deal with co-production situations where elementary flows need to be allocated to the different products. However, the ISO standards can still lead to different methodological decisions, depending on the LCA practitioner's interpretation. This means that applying the ISO standards may still result in different approaches and different quantitative results.

That's why the more specific methodologies as defined in the PEF framework are relevant. They define in more detail how to model emissions in agriculture and other aspects such as system boundaries and allocation. Agri-footprint aligns to these specific requirements.

3.2 Included processes

Agri-footprint contains LCIs of animal and plant agricultural production, fisheries and derived processed products. Furthermore, it contains datasets for transport, energy production and some chemicals that are used to produce these products. These unit processes are linked in Agri-footprint to produce commonly used agricultural commodities. The system boundaries are from cradle to the exit gate of the plant-based or animal-based food commodity as shown in the figures of Section 3.6 System Boundaries. Retail, preparation by the consumer, and waste treatment after use are not incorporated in Agri-footprint. Consumer and distribution packaging this is not included in Agri-footprint, apart from pesticide packaging. However, for several commodities and regions Agri-footprint provides market and production mixes based on production and import statistics (see Agri-footprint 8 - Part 2 – Description of data).

The processes in Agri-footprint reflect an average performance for a defined region, for instance wheat cultivation in the Netherlands, or crushing of soybeans in the United States. The data description section of the report (Agri-footprint 8 - Part 2 – Description of Data) gives

more detail on how the data is generated. For the United States of America and Australia state specific datasets are available for some cultivations.

3.3 Consistency of methods, assumptions, and data

The data in Agri-footprint are derived from different sources. The LCIs for the animal production systems, transport, auxiliary materials, fertilizers, etc. have been developed based on own work of Blonk Sustainability. In these studies, data were collected mainly from the public domain (scientific literature, FAOstat, Eurostat, etc.) or from public or confidential research initiated by the industry and conducted by Blonk Sustainability. Where possible, the data has been reviewed by industry experts. Data gaps were filled with estimates, which were based on industry expert opinions as much as possible. The assumptions are documented in Part 2 and clearly identified in the database.

3.4 Function, functional unit, and reference flow

Products can fulfill different functions, which depend on the context in which they are used. It is therefore not possible to define a complete functional unit for every product in the database. Rather, reference flows can be defined which can fulfill different functions in different contexts. To allow for maximum modelling flexibility, multiple properties of the reference flows are provided in the database. For example, the main reference flow for crop cultivation is 1 kg of crop, but the dry matter and energy content are given as additional properties. The general principle used in Agri-footprint is that the reference flows of products reflect 'physical' flows as accurately as possible, i.e. reference flows are expressed in kg product "as traded"; including moisture, formulation agents etc., with product properties listed separately in the process name and/or comment fields.

3.5 Multi-functional processes

According to the ISO14044:2006 standard (ISO 14044, 2006), allocation should be avoided whenever possible by dividing the unit multi-output process into two or more sub-processes and collecting the inventory data related to these sub-processes separately. In practice this is, however, not possible and therefore allocation keys are used to divide impact of the process and precursor processes in the supply chain over the co-products. Agri-footprint provides three types of allocation: *mass allocation*, *energy allocation* and *economic allocation*.

- **Mass allocation:** For the crops and the processing of the crops, mass allocation is based on the mass of the dry matter of the products. For animal products, mass allocation is based on the mass as traded.
- **Gross energy allocation:** For the crops and the processing of the crops, gross energy allocation is based on the gross energy of products. For more information on the data behind the gross energy of products see 'Agri-footprint 8 - Part 2 – Description of Data'.
- **Economic allocation:** For the crops and the processing of the crops the economic value of the products is largely based on (Vellinga et al., 2013). For the other products, the references to the economic value are given in the chapters on these products in 'Agri-footprint 8 - Part 2 – Description of data'. Economic allocation is the preferred allocation method, since it is PEFCR Feed compliant (PEFCR, 2018a).

For some specific products the Economic allocation applied is "0" as a results, this happens when the economic value of it is not present, it is mostly present in co-products:

- Sunflower hull
- Vinsasse wet
- Pig co-product, other
- Beef co-product, other (from various systems)
- Dairy cow co-product, other
- Egg losses
- Groundnut shells
- Sugar beet pulp wet

Allocation is applied without the use of cut-offs for so-called residual product streams whenever possible. There are four exceptions to this allocation rule:

- Brewer's grains, wet
- Citrus pulp, wet
- Animal manure
- Offal, from fishery

These exceptions are according to the recommendations of the PEFR Feed, FAO LEAP (Livestock Environmental Assessment and Performance Partnership) guidelines for feed and animal systems. Citrus pulp, wet brewer's grain and manure do not include any inputs from previous life cycle stages. Dried citrus pulp only includes the energy required for drying.

In accordance with the limits of our system, we consider animal manure a waste product, meaning it does not carry any environmental impacts from the livestock stage. Therefore, while the impacts of manure storage are attributed to the animal system, the emissions from its application in the fields correspond exclusively to the cultivation process.

Products are considered residual when they have the following characteristics:

- Former food product for feed
- Marginal revenue share
- Production volume is independent of the demand for the rest-product
- Often products with limited shelf life, e.g. wet materials

3.6 System boundaries

Agri-footprint includes the interventions between technosphere and ecosphere that occur during normal operation (thus excluding accidents, spills, and other unforeseeable incidents). For agricultural soil which is partly technosphere and partly ecosphere Agri-footprint follows the definitions of the PEF impact models used for modelling ecotoxicity and eutrophication.

The LCI data is 'cradle-to-gate', where the gate is dependent on the process analyzed. No data on distribution to retail, retail, consumer use or end-of-life (after the use phase) are provided (but treatment of waste generated during processing is included). All processes that are relevant for analysis on an attributional basis are included. Any omission or deviation is documented in the documentation of the specific process.

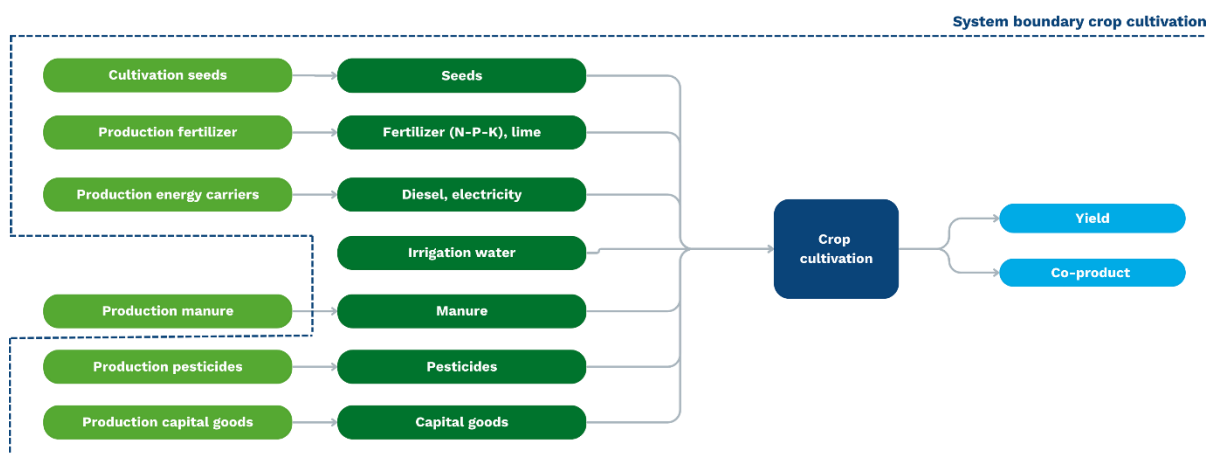


Figure 3-1: System boundary for crop cultivation.

Crop cultivation (Figure 3-1) is modelled on the country-level (with country specific crop yields, fertilizer composition and application rates and energy use). Carbon storage in crops for feed, animals and milk is not included in Agri-footprint because this carbon is part of the short-term carbon cycle. Because of this, the carbon dioxide emissions at the end of the life cycle (e.g. emitted during fermentation or digestion) should not be modelled as a CO₂ emission contributing to climate change except when the stored carbon is released as methane due to, for instance, enteric fermentation or manure management and storage, which is inventoried as 'methane, biogenic'. After cultivation some crops undergo a country-specific processing stage (e.g. crushing of palm fruit bunches), see Figure 3-2.

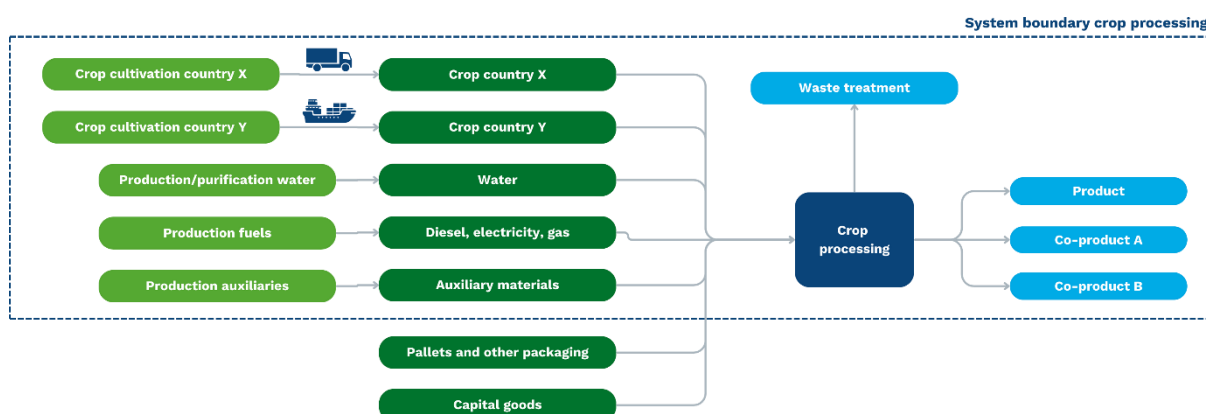


Figure 3-2: System boundary for crop processing.

Production of fuels, auxiliaries, and transport of crops and materials to the crop processing site are included. Intermediate packaging and capital goods are excluded from the system boundaries. The partially processed product may then be exported to another country for further processing or be processed further domestically (e.g. palm oil refining). After this second processing step, country-specific crop product mixes may flow into various feed ration mixes (e.g. cattle feed compound). The feeds are an input for the animal husbandry, see Figure 3-3.

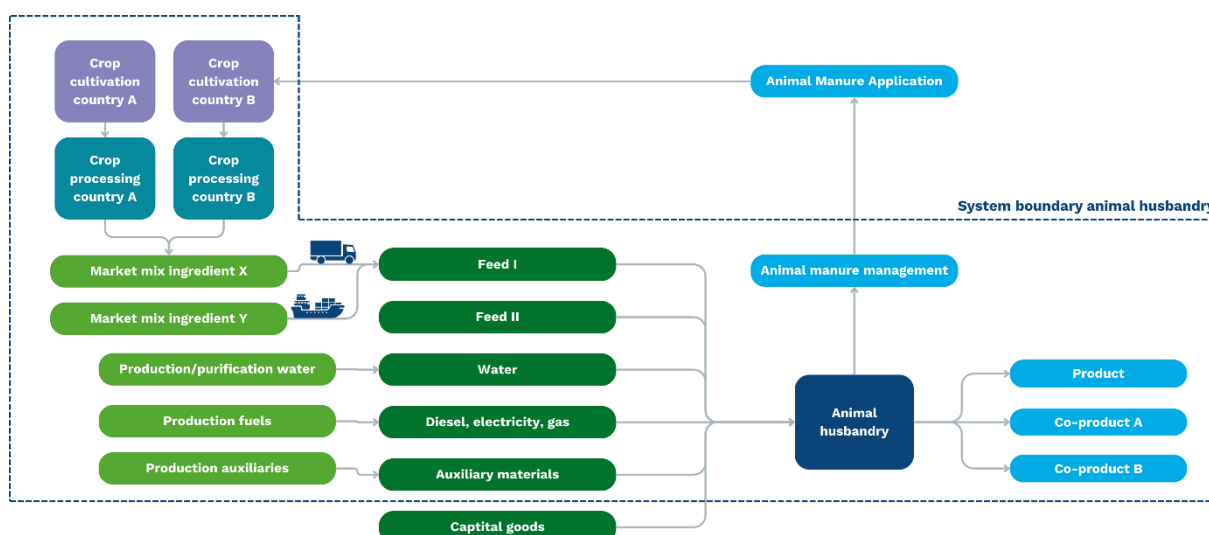


Figure 3-3: System boundaries for animal husbandry.

In Agri-footprint, market mixes are derived for many feed materials that are used for the compound feeds fed to chicken, pigs and cattle. Emissions due to the management of manure on the farm are included within the system boundaries, but the emissions due to application of manure are attributed to the crop cultivation stage. This is not done via a loop, but when a crop is cultivated using manure this is modelled within the crop cultivation itself, not considering any emissions from animal husbandry. So, the manure is treated via a cut-off. Emissions due to animal manure transport to the field are 100% allocated to crop cultivation.

Plant and animal products can be further processed into food ingredients, see Figure 3-4. For food ingredients that originate from the processing of crops, the system boundary is drawn after the processing into 'generic' ingredients (e.g. into starch, sugar, vegetable oil etc.). These products are often processed further into food products (e.g. bread, soft drinks). This further processing is not included in Agri-footprint.

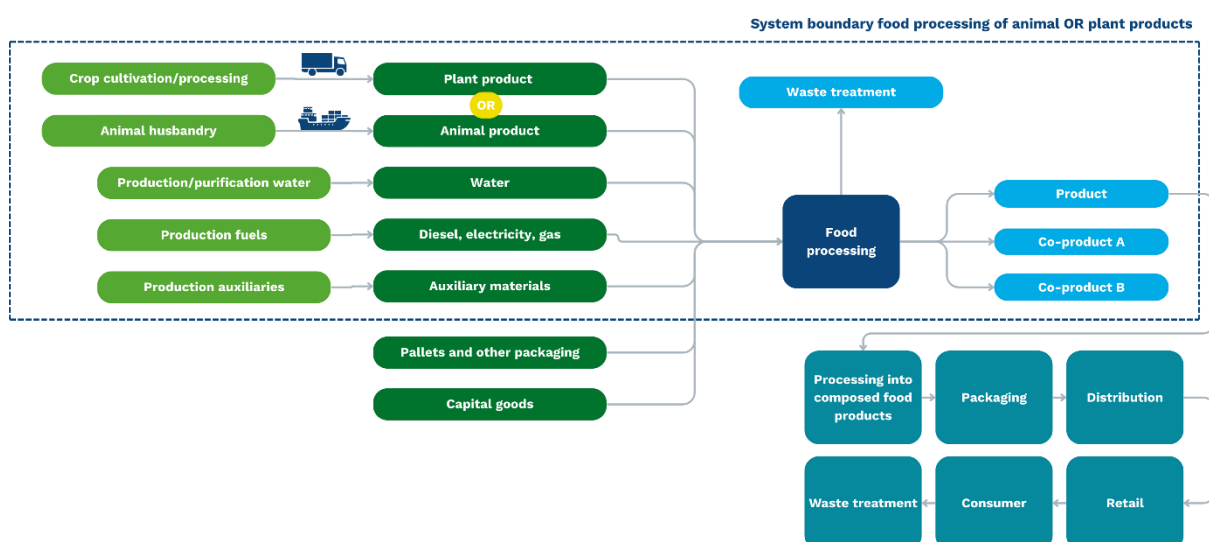


Figure 3-4: System boundaries for food processing.

For meat, the processing of fresh product means that the animal is slaughtered and fresh meat is produced, but further processing into specific meat products and packaging for retail is not included. Agri-footprint excludes packaging, distribution, retail, consumer handling and waste treatment of the final product.

Some processes may be excluded from the system, because there is only a remote relation to the most important processes in the lifecycle of the product. A key consideration here is the use of capital goods (e.g. tractors, barns, farmstead, processing plants, mills, trucks, ships). The energy and materials production in the supply chain of capital goods often make a negligible (not substantial or significant) contribution to the LCA results and have not been incorporated into Agri-footprint.

3.7 Cut-off

The cut-off criteria for the inclusion of inputs and outputs were based on mass and/or energy consumption. It is estimated that elementary flows representing not more than 2% of the cumulative mass and energy flows were omitted.

3.8 Basis for impact assessment

The LCIA methods ReCiPe 2016 v1.13 (M. Huijbregts et al., 2016), the Blonk version 4.2.0, based on ReCiPe 1.13 (SimaPro adapted) and the EF 3.1 (SimaPro adapted) method were considered when developing Agri-footprint, but Agri-footprint may also support other impact assessment methods.

In Agri-footprint, climate change due to land use change and peat has been modelled separately to show its contribution to the climate change impact category. This makes it possible to report on the effects of land use change and peat emissions separately. Land transformations are also modelled in m² land transformation in the known inputs from nature. Although m² land transformation contributes to other environmental indicators than carbon dioxide, please keep in mind that double counting of the impact of land use change should be avoided.

Agri-footprint makes use of other databases such as Ecoinvent to provide data for some background processes. If LCIs of other databases are used, it is possible that errors have occurred during the implementation of those datasets into third party LCA-software. It remains to the user of Agri-footprint to select the impact categories that are environmentally relevant for the analyzed products or systems and to check which impact categories are endorsed by other bodies of the relevant region. The inventories in Agri-footprint support the calculation of the midpoint impact categories being proposed in the EU PEF.

3.9 Treatment of uncertainty

Uncertainty in inventory data exists in many ways and there are many factors determining the level of uncertainty in LCA (M. A. J. Huijbregts et al., 2001). Most of the inventory data in Agri-footprint are not the result of actual measurements but of models that compute inventory data in relation to activity data that are on its turn measured or estimated. We use the following classification derived from (M. A. J. Huijbregts, 2001) to explain the different types of uncertainties and how we have treated and estimated uncertainties:

1. Uncertainty due to LC modelling choices which are related to the simplifications made in modelling the lifecycles, for instance by using cut-off rules for marginal inputs and outputs or excluding not common situations in defining the average lifecycle;
2. Data uncertainty which encompasses inaccuracy of data and lack of (representative) data;
3. Emission model and parameter uncertainty which refers to the many emissions which are calculated by combining primary activity data with an emission factor that is the result of a parameterized model;

4. Spatial variability refers to the variation in conditions (soil, climate) and applied technologies (age, type, abatement techniques, etc.) the region under study
5. Temporal variability refers to variation in time related to variation in natural conditions over the years (climate, pests, capacity usage, calamities, et cetera).

3.9.1 Which uncertainty types are included and how

In Agri-footprint, uncertainty distributions are defined for specific input or output data of LCI processes that incorporate some main factors defining uncertainty and variability around the average. There we focus on key parameters related to the average efficiency of processes in the regions for which average process data are derived. This overall distribution combines the variability in technology, processing conditions and management, which may have a spatial correlation in that region (see Table 3-1 for further explanation).

Table 3-1: Overview of applied uncertainty models and parameters in Agri-footprint

Process group	Parameters that define process efficiency	Explanation
Cultivation	Yield (kg crop/ha)	In a defined cropping system where agricultural practice is more or less the same (for instance conventional winter wheat grown in the Netherlands), the differences in emissions and resource use per unit product are strongly related to differences in yield. Yields vary in relation to differences in climate and local growing conditions with same inputs and related emissions per hectare (at least if we assume that emissions are not related to factors that also explain the variation in yield, e.g. rainfall can affect yields but also runoff of N-fertilizer). Of course, yields are also correlated with agronomic inputs such as fertilizers. This change in yields per hectare caused by a change in inputs per hectare causes mostly a smaller effect on emissions and resource use per kg product, because the yield responses to marginal inputs. Since emissions in cultivation are all related to agronomic inputs and these inputs are on its turn related to yield, we decided not to introduce variations on inputs and yields at the same time. The distribution around the average yield gives a first proxy for many of the inputs and related emissions.
Transport	Performance (tkm) per unit fuel	Also, here many factors determine emissions and resource use of a specific transport modality over a certain distance. Similar to cultivation there are many interrelations between input emissions and performance. In this version of Agri-footprint we only set a distribution on fuel efficiency (same as yield in cultivation).
Processing of food crops	Energy use per unit production	LCA contribution analysis of processing shows that energy use is for many environmental impacts the most important contributor. From our industry assessments of variation in energy use in European sectors, we know that a factor 2 difference between the best and worst performing factories is quite common. This variation is explained by the applied technology, age of equipment, plant management and capacity/production rate. All these factors can differ considerably. In Agri-footprint we do not include uncertainty estimates but explain in the meta information the representativeness of the data.
Production of fertilizers	Energy use per unit production	The average LCA impact of fertilizer production is mainly determined by energy use, type of energy source and efficiency of production of this energy source and N ₂ O emissions. Before we included

		uncertainty for energy use. Now we have regionalized the N-production, and we did not add uncertainty data
Animal production	Yield (kg milk/cow; piglets/sow; kg pig/kg feed; kg broilers/feed, number of eggs/kg feed)	The main parameter explaining environmental performance of animal production systems is the Feed Conversion Rate, how efficient feed inputs are transferred to the animal product. We do not add uncertainty data on feed conversion ratio in Agri-footprint 8. We expanded the amount of regional production types instead.

4. Data development and procedure

A four-stage data development procedure is used for the development of the Agri-footprint database. Each stage of the procedure focusses on different aspects, to ensure an efficient but at the same time robust work procedure. Each step of the procedure.

1. Establish the unit process baseline model
2. Identify data sources and aggregation level of data
3. Fill data gaps with best available data
4. Consistency checks

4.1 Establish the unit process baseline model

For all processes, a default model is used consisting of calculation rules that transfer the input data into the interventions. Together they form the unit process. In Agri-footprint, the unit process data is not pre-allocated which allows the user to adapt the allocation factors. These models have been developed in the past and are compliant to the PEF methodology and the GFLI handbook (European Commission, 2018b; GFLI, 2020a, 2020b).

Agri-footprint contains attributional LCIs, which means generally average mixes are considered that are representative for the specific crop, process, transport modality, product or location.

4.2 Selection of data sources and aggregation of data

For Agri-footprint, we aim to use consistent data for all crops and regions covered. For example, all fertilizer application rates, fertilizer types, water use etc. are based on the same methodologies and data sources for all crops.

The main baseline data source is statistics available in the public domain (Scientific literature, FAOstat, Eurostat, etc.). Data from the public domain is assessed based on representativeness (time-related coverage, technical coverage and geographical coverage), completeness, consistency and reproducibility. For a part of the data, we cannot rely on statistics. There we use literature data and models developed by Blonk (for instance for energy use at the farm). For processing, we rely on literature and industry data (either published or collected by Blonk). Where possible, the data has been reviewed by industry experts.

For state level data from the United States and Australia, specific data from USDA (Taylor, et. al. 2025) and AusLCI was used (AusLCI, 2026) Which makes these datasets inconsistent with the data sources used for all other generic AFP datasets, but these state specific datasets are considered to be more precise.

Fertilizers production was modeled based on the latest available literature and the modeling of a specific fertilizer product. Auxiliary materials were based on the Ecoinvent database or literature sources.

Processing inventories were initially drawn from the feedprint study (Vellinga et al., 2013). These inventories are generic for all provided countries and regions. These processes are either largely similar between countries or the data available was not specific enough to create country/ region specific processes. These generic processes are regionalized by adapting emissions and inputs for energy consumption to the country or region where the processing takes place. This means that the processing (mass balances, inputs etc.) is the same for all regions. Therefore, the representativeness may have decreased for these processes (as the

geography of the data is “other region assumed similar”). During the development of Agri-footprint releases, many of these ‘feedprint’ processes have been replaced by higher quality processes using region specific / higher quality data (see Part 2 of the report).

Transport distances and modes from and to the processing plant are also country specific. We connect her to the modelling rules as defined in the Feed PEFCR (European Commission, 2018b).

The aim for the LCI data is to be as recent as possible, which means that when better quality data or statistics on the processes/ systems are available, these will be incorporated in Agri-footprint, generally using five-year averages. To ensure the best time-related representativeness, data will be updated regularly.

4.3 Filling data gaps using best available data

LCIs have been developed specifically for Agri-footprint or as part of previous confidential or public studies conducted by Mérieux NutriSciences | Blonk. These LCIs are fully reported or referred to in part 2.

Data gaps are filled with estimates, which are as much as possible based on expert opinions and previous experiences. The assumptions are documented in part 2 and clearly identified in the database. When fit, the uncertainty range reflects the fact that assumptions have been made.

Many unit processes require energy consumption (e.g. natural gas), fertilizers (e.g. Calcium Ammonium Nitrate) or auxiliary materials (e.g. hexane). Energy related LCIs are taken from the Ecoinvent database. These are consumption mixes for specific countries or regions.

4.4 Data quality checks during modelling

As the original data has been compiled in different software programs and data structures, it is important to check consistency and correctness of all the data during the implementation process (the migration to a SimaPro database). Quality checking has been done iteratively. (Parts of) the database was exported to SimaPro, checked, errors or inconsistencies corrected, and data gaps identified. When identified issues were resolved, a new SimaPro export was made, this was again checked. This process continues until all identified errors and data gaps were resolved. The checking process involves:

- Check naming
- Remove duplicate processes, or processes that were very similar (e.g. wheat starch slurries with slightly different starch contents).
- Check correct linking
- Remove empty processes whenever possible
- Check if newly added processes or flows are applied consistently throughout the database.
- Mass balances
 - Balances; the amount of dry matter going in should be the same as dry matter going out as product or waste/emission. The total matter ‘as is’ should be balanced as well. Sometimes it was possible to also calculate balances of substances (e.g. hexane make-up should be balanced by hexane emissions during crushing).
 - Appropriate waste flows

- Transport included in all processes
- Logical differences between countries (yields, fertilizer application rates, et cetera)
- Consistent calculation methodology
- Compare results to existing data from other sources.

4.5 Data Quality Ratings (DQR)

New data quality rating system for Agri-footprint will be implemented in the next versions, based on the new EF Data Quality Rating rules for datasets that have been developed by the JRC for Environmental Footprint compliant datasets.

4.6 External Review

Agri-footprint 8 was reviewed by Agroscope. This critical review was performed to ensure compliance with ISO 14040 (ISO, 2006a), 14044 (ISO, 2006b) on the following points:

- The methods used for the LCIs are consistent with this International Standard,
- The methods used for the LCIs are scientifically and technically valid,
- The data used is appropriate and reasonable in relation to the intended goal of the LCIs.

This critical review;

- is performed at the end of Agri-footprint 8 development,
- includes an assessment of the LCI model,
- includes life cycle impact assessment (LCIA).

5. Limitations of Agri-footprint

There are a number of limitations that should be considered when using Agri-footprint. Some additional limitations apply to specific processes; these limitations are reported in the data description section of that specific dataset (in 'Agri-footprint 8 - Part 2 – Description of data').

Agri-footprint provides LCIA results with a standard reference unit of 1 kg “as is”, for all mass-based products. Other processes, like transport, heat and electricity datasets use have different functional units (tkm, MJ and MJ respectively), It is the responsibility of the user to determine an appropriate basis for comparison (functional unit).

The impact categories of ReCiPe and EF were considered when developing Agri-footprint. Agri-footprint uses some background data that is sourced from Ecoinvent. Where LCIs of other databases are used, it is possible that errors have occurred during the development of those datasets or during implementation into third party LCA-software, the correction of these errors is beyond the control of the Agri-footprint development team. Naturally, errors that were discovered in those datasets were reported to the appropriate parties.

Elementary flows have been collated to align with requirements of ReCiPe and EF method. Other LCIA methods may assess substances which are not included in Agri-footprint.

There are methodological limitations of LCA, which are not specific to Agri-footprint, but which are relevant for all agricultural and food product life cycle inventories:

- Use of statistical data for crop yields, (artificial and organic) fertilizer application rates, when there is not specific data available.
- Data availability is also limited in relation to production and the use of pesticides (impacting on eco-toxicity), but an approach was developed to estimate the impact on ecotoxicity of agricultural cultivation.

The system boundaries which are supported by Agri-footprint are from cradle (cultivation) to factory or farm gate. The processes can be used to support LCAs from cultivation to end-of-life, but Agri-footprint does not contain processes for life cycle phases such as packaging, distribution and retail, consumer storage and preparation or waste treatment.

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